# THE EFFECTS OF CIGARETTE BANDING ON SMOKING BEHAVIOR, PERCEPTION, AND EXPIRED-BREATH CO CONCENTRATION.

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# Abstract


- We tested two commercial 85-mm "light" cigarettes (A and B) with similar FTC yields. Only B had a brand logo (BL). Besides examining the effect of the BL, we examined whether the addition of paper bands 10 mm in width (covering the BL on B) affected smoking behavior, perceptions, and breath-CO concentration. Fifty-one smokers participated - 26 with usual brand (UB) A and 25 with UB B. Participants smoked four cigarettes (banded and un-banded versions of A and B) in a balanced order, one every 30 minutes. On average, banded cigarettes of both brands burned about 5% longer. Smokers of cigarette A (no BL) took more puffs with greater total puff volume when smoking banded vs. un-banded A. Smokers rated banded cigarette B (BL obscured) as being less satisfying, less smooth, stronger, harsher, and having more aftertaste than un-banded B (BL visible). UB smokers of B rated the un-banded version of B as having lower throat impact and a much higher acceptance score than banded B. No effects for breath CO were significant. Though testing cigarettes with banding may lead to minor effects on smoking behavior, banding is preferable when testing subjects smoking their UB cigarette due to the large impact of a visible BL on smoker perceptions.

# Introduction

- Human smoking behavior (HSB) studies in our laboratory have demonstrated the wide variety of behaviors exhibited by smokers. No two individuals smoke a cigarette in the same manner, and the same individual smokes the same cigarette differently at different times. The smoker's perception of a cigarette is affected by physical characteristics of the cigarette such as "draw"/pressure drop, and sensory characteristics such as strength and aftertaste. Perception is also affected by visual cues such as cigarette brand logo.

- When evaluating cigarettes in HSB studies, it is often useful to present one or more cigarettes to smokers with no identifying marks. This is especially true when the participant is smoking her/his UB, thereby removing expectations that the person may have acquired and providing a more balanced comparison of different cigarettes. One means of removing a visible logo cue is to obscure the logo with a paper band. The current studies compared smoking behavior, sensory perception, and expired-breath carbon monoxide concentration when participants smoked banded and un-banded cigarettes, including their UBs.

# Methods

Smokers

- In each study, participants were recruited from the local community.
- They reported being smokers of at least 15 full flavor low 'tar' (FFLT) or "light" cigarettes per day.
- Participants provided informed consent prior to any experimental testing.

| | Study 1 | | Study 2 | |
|---|---|---|---|---|
| | UB A | UB B | UB A | UB B |
| • Male | 14 | 14 | 13 | 15 |
| • Female | 12 | 11 | 13 | 12 |
| • TOTAL | 26 | 25 | 26 | 27 |
| • Age Range | 21-48 | | 21-48 | |
| • Average Age | 33.2 | | 32.6 | |

Cigarettes

- A and B were commercially available 85 mm filtered "light" cigarettes; C was an experimental prototype cigarette.
- Cigarette B had a brand logo while Cigarettes A and C did not.
- Participants smoked banded and un-banded versions of both commercial cigarettes (four cigarettes total) in Study 1; in Study 2 they smoked banded and un-banded versions of Cigarettes B and C.
- Paper bands covered the location of the logo on Cigarette B on all banded cigarettes. Bands in Study 1 were 10 mm wide while in Study 2 they were 12 mm wide.
- Machine yields for the cigarettes by the FTC method (35 cc puff of 2 s duration taken once every 60 s) are shown below. All results are in mg/cig.

| | 'Tar' | Nicotine | Carbon Monoxide (CO) |
|---|---|---|---|
| • A | 10.9 | 0.90 | 11.8 |
| • B | 10.7 | 0.90 | 11.8 |
| • C | 10.8 | 0.88 | 10.8 |

# Methods

Smokers on each study test panel reported for one two-hour test session in the afternoon. Procedures described were common to both studies. Study endpoints included puffing profiles (which provided a standard set of smoking behavior measures), cigarette sensory attribute ratings, and pre- and post-smoking expired-breath CO concentration (in parts per million, or ppm).

Participants were instructed to refrain from smoking 15 minutes before the test session. They reported the number of cigarettes already smoked that day prior to testing. Participants sat in comfortable chairs and watched a movie to provide a relaxed setting during the session. Partitions between the smokers, who were generally tested in groups of six, prevented observation of cohort behavior while smoking.

A pre-smoking (0 minute) expired-breath sample for measurement of CO concentration was collected. The first of the four cigarettes, equipped for puff profile measures, was then lighted and the participant smoked as desired. After smoking, the participant completed questionnaires scoring various sensory attributes of the cigarette. An additional expired-breath sample was collected 25 minutes post-lighting.

The second cigarette was lighted thirty minutes after the first, following all procedures as with the first smoking. Cigarettes three and four were then smoked 30 minutes after cigarettes two and three. Cigarettes were presented to smokers in an approximately balanced order. Participants were financially compensated at the conclusion of the test session.

# Methods

Puffing Behavior

- Puffing data including number of puffs, puff volume (Vol), and puff duration (Dur) for each participant were monitored during smoking and recorded on diskette using portable puff profilers. Other smoking behavior parameters generated in post-smoking processing included inter-puff interval (IPI), time alight (Lit), smolder time (Smolder), total puff volume (TVol), and total puff duration (TDur).

Subjective Responses

- Questionnaires were used to assess a variety of smoker sensory impressions concerning the cigarettes, including overall cigarette acceptance and several cigarette attributes.

Expired Breath CO

- Participants were instructed to take a deep breath, to expel approximately half of it, and to blow the remaining portion into a Teflon® sampling bag, exhaling fully. CO levels (in ppm) were then measured using an INTERSCAN 1000 portable CO monitor.

# Results

- The primary method of hypothesis testing was analysis of variance (ANOVA), and p-values of less than 0.05 were specified for statistical significance. An asterisk (*) indicates significantly different results in the figures.

# Results

Results for puffing behavior are shown in Figures 1, 2, 3, and 4, normalized to UB for convenient visual comparisons.

## Study 1

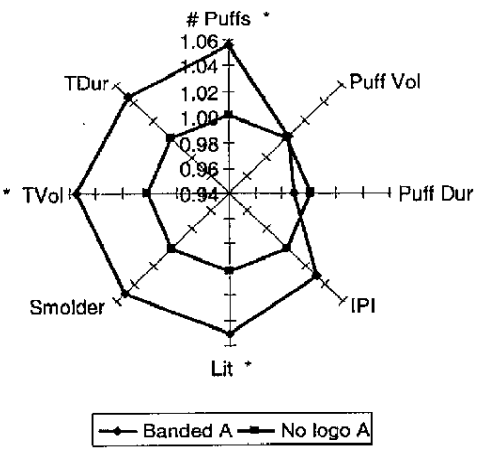


Figure 1

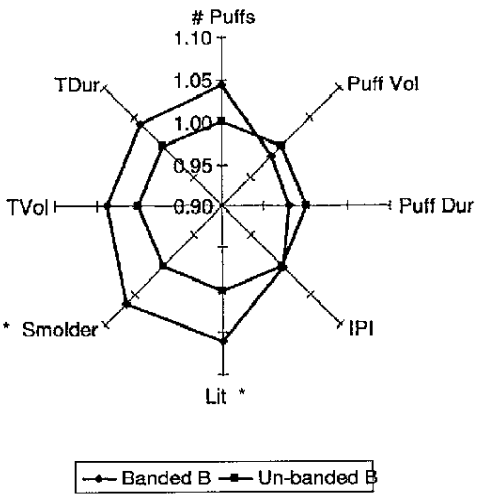


Figure 2

## Study 2

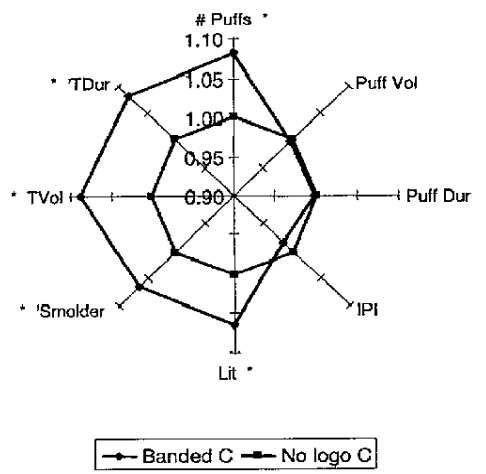


Figure 3

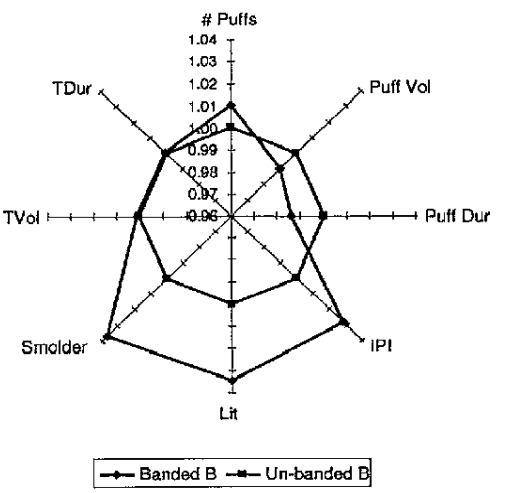


Figure 4

Study 1 - Banded A and B burned about 5% longer than un-banded A and B. Smokers took more puffs and had a greater total puff volume with banded vs. un-banded A.

Study 2 – Banded C burned longer (6.4%) than un-banded C. Smokers took more puffs and had a greater total puff volume with banded vs. un-banded C.

# Results

Attribute ratings (scale 1-7) results are shown in Figures 5, 6, 7, and 8.

## Study 1

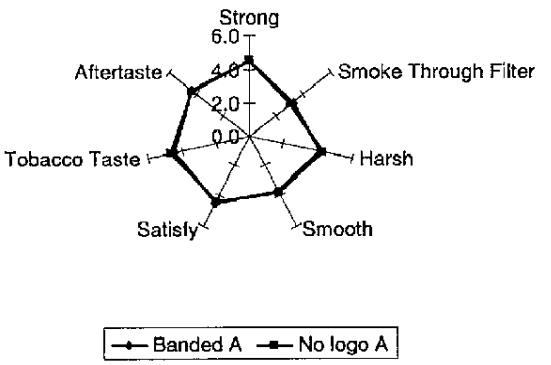


Figure 5

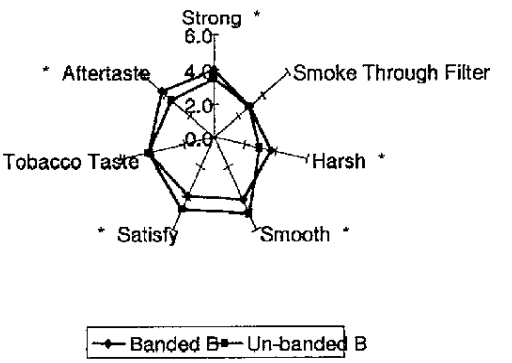


Figure 6

## Study 2

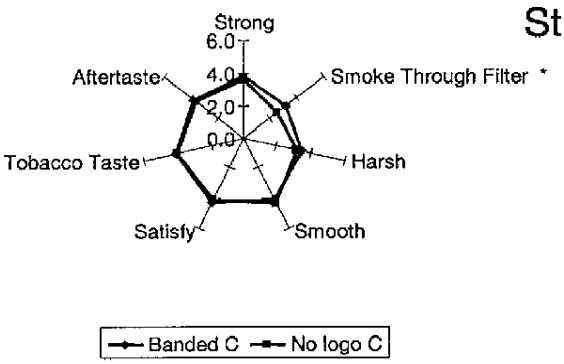


Figure 7

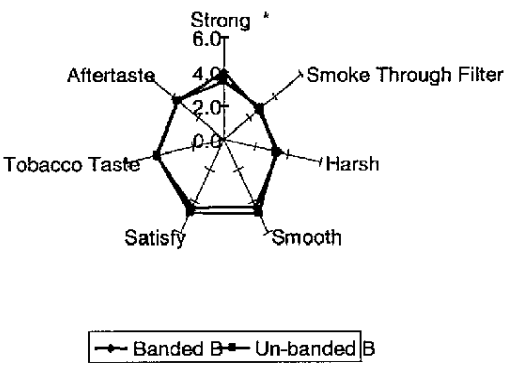


Figure 8

Study 1 – Banded B was rated by smokers as stronger, harsher, less smooth, less satisfying, and having more aftertaste than un-banded B.

Study 2 – Banded B was rated by all smokers only as stronger compared to un-banded B.

(Smoke Through Filter refers to how hard the participant feels s/he has to puff to receive smoke through the cigarette filter.

# Results

## Attribute Ratings by Usual Brand

Study 1

| Attribute | Usual Brand | Banded A | No logo A | Banded B | Un-banded B |
|---|---|---|---|---|---|
| | | | | | |
| **Nose Impact** | A | 2.7 | 2.4 | 2.5 | 2.4 |
| | B | 3.4 | 3.2 | 2.7 | 2.7 |
| **Mouth Impact** | A | 4.2 | 3.8 | 3.6 | 3.4 |
| | B | 4.8 | 4.8 | 4.1 | 3.6 |
| **Throat Impact** | A | 3.3 | 3.7 | 3.4 | 3.4 |
| | B | 4.3 | 4.6 | **3.7** | **2.8 *** |
| **Chest Impact** | A | 2.8 | 3.2 | 3.2 | 2.9 |
| | B | 4.0 | 4.2 | 3.2 | 2.8 |
| **Acceptance** | A | 67.7 | 63.1 | 51.5 | 52.7 |
| | B | 52.4 | 54.0 | **59.6** | **81.2 *** |

Study 1 – UB smokers of B rated the banded version only as having greater throat impact than un-banded B. However, they rated it much lower in overall acceptance.

# Results

## Attribute Ratings by Usual Brand

Study 2

| Attribute | Usual Brand | Banded C | No logo C | Banded B | Un-banded B |
|---|---|---|---|---|---|
| | | | | | |
| Nose Impact | A | 2.6 | 2.6 | 2.7 | 2.6 |
| | B | 2.7 | 2.3 | **3.0** | **2.1** * |
| Mouth Impact | A | 3.2 | 3.5 | 3.9 | 3.8 |
| | B | **4.1** | **3.3** * | 3.7 | 3.1 |
| Throat Impact | A | 3.0 | 2.9 | 3.3 | 3.4 |
| | B | 3.5 | 3.2 | **3.6** | **2.3** * |
| Chest Impact | A | 2.6 | 2.8 | 2.8 | 2.7 |
| | B | **3.5** | **2.8** * | **3.3** | **2.5** * |
| Strong | A | 3.4 | 3.4 | 3.8 | 4.0 |
| | B | 4.3 | 3.8 | **4.1** | **3.0** * |
| Smoke Through Filter | A | 3.1 | 2.6 | 2.5 | 3.0 |
| | B | **3.2** | **2.6** * | 2.9 | 2.7 |
| Harsh | A | 3.1 | 2.9 | 3.5 | 4.0 |
| | B | 3.9 | 3.4 | **3.3** | **2.4** * |
| Smooth | A | 4.6 | 4.5 | 4.4 | 4.1 |
| | B | 3.7 | 4.2 | **4.4** | **5.6** * |
| Satisfy | A | 4.4 | 4.0 | 4.2 | 3.7 |
| | B | 4.2 | 4.3 | **4.6** | **5.7** * |
| Acceptance | A | 59.6 | 57.7 | 61.9 | 55.8 |
| | B | 55.9 | 58.1 | **65.2** | **83.3** * |

Study 2 – UB smokers of B rated the banded version as having greater nose, throat, and chest impact, in addition to being stronger, harsher, less smooth, and less satisfying than un-banded B. Again, overall acceptance was much lower for banded B vs. un-banded B.

# Summary

- Smokers of cigarettes with no logo (A in Study 1 and C in Study 2), took more puffs with greater total puff volume when smoking banded vs. un-banded cigarettes.

- Smokers in Study 1 rated banded Cigarette B (brand logo obscured) as overall less acceptable, and in general having ratings that we might consider more "negative" or less "positive" than un-banded B (brand logo visible). In contrast, smokers in Study 2 rated banded B only as more strong and less acceptable.

- UB smokers of Cigarette B in Study 1 rated the un-banded version of B as having lower throat impact and a much higher acceptance score than banded B. In Study 2, UB smokers of B rated the un-banded version of B again as having a much higher acceptance score, and generally more "positive" ratings than banded B. No such pattern was observed for UB smokers of Cigarette A, with no visible brand logo.

- In general, no effects for expired-breath CO were significant. Expired-breath CO may be too variable an index to detect effects on smoke intake related to puffing parameters in this type of study.

- Testing cigarettes with paper banding may lead to minor effects on smoking behavior, as indicated by results in these studies. However, the visible brand logo (Cigarette B) impacted several subjective measures, especially acceptance. These results appeared unrelated to banding itself since similar results were not observed for banded vs. un-banded A or C. Banding is therefore preferable when testing participants smoking their UB cigarette due to the large impact of a visible brand logo on smoker perceptions.